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Abad et al.

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(54) **ARCHITECTURE, SYSTEM AND METHOD FOR MODULAR ENVIRONMENTAL CONDITIONS AND OBJECT SENSING**

(58) **Field of Classification Search** 340/870.07, 340/870.09, 870.11
See application file for complete search history.

(76) Inventors: **Vahid Zarei Seyd Abad**, Agoura Hills, CA (US); **Ramin Rostami**, Calabases, CA (US); **Masoud Zarei**, Tarzana, CA (US)

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Primary Examiner — Hal Kaplan

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(74) *Attorney, Agent, or Firm* — Merle W. Richman, Esq.

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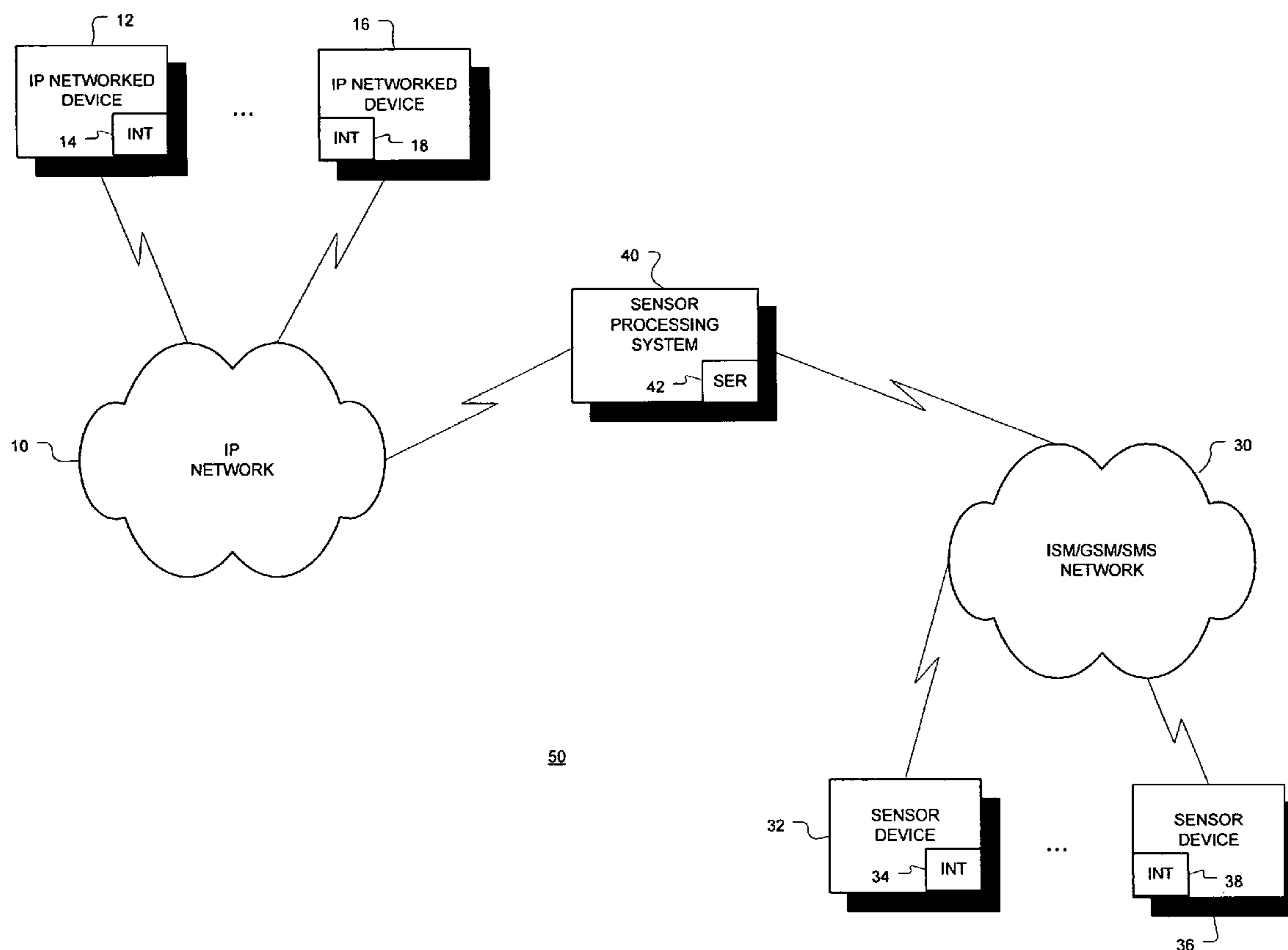
(57) **ABSTRACT**

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H04Q 9/00 (2006.01)
G08B 19/00 (2006.01)

Embodiments of modular environmental conditions and object sensing at several locations are described generally herein. Other embodiments may be described and claimed.

(52) **U.S. Cl.**
USPC 340/870.07; 340/870.09; 340/870.11

22 Claims, 8 Drawing Sheets



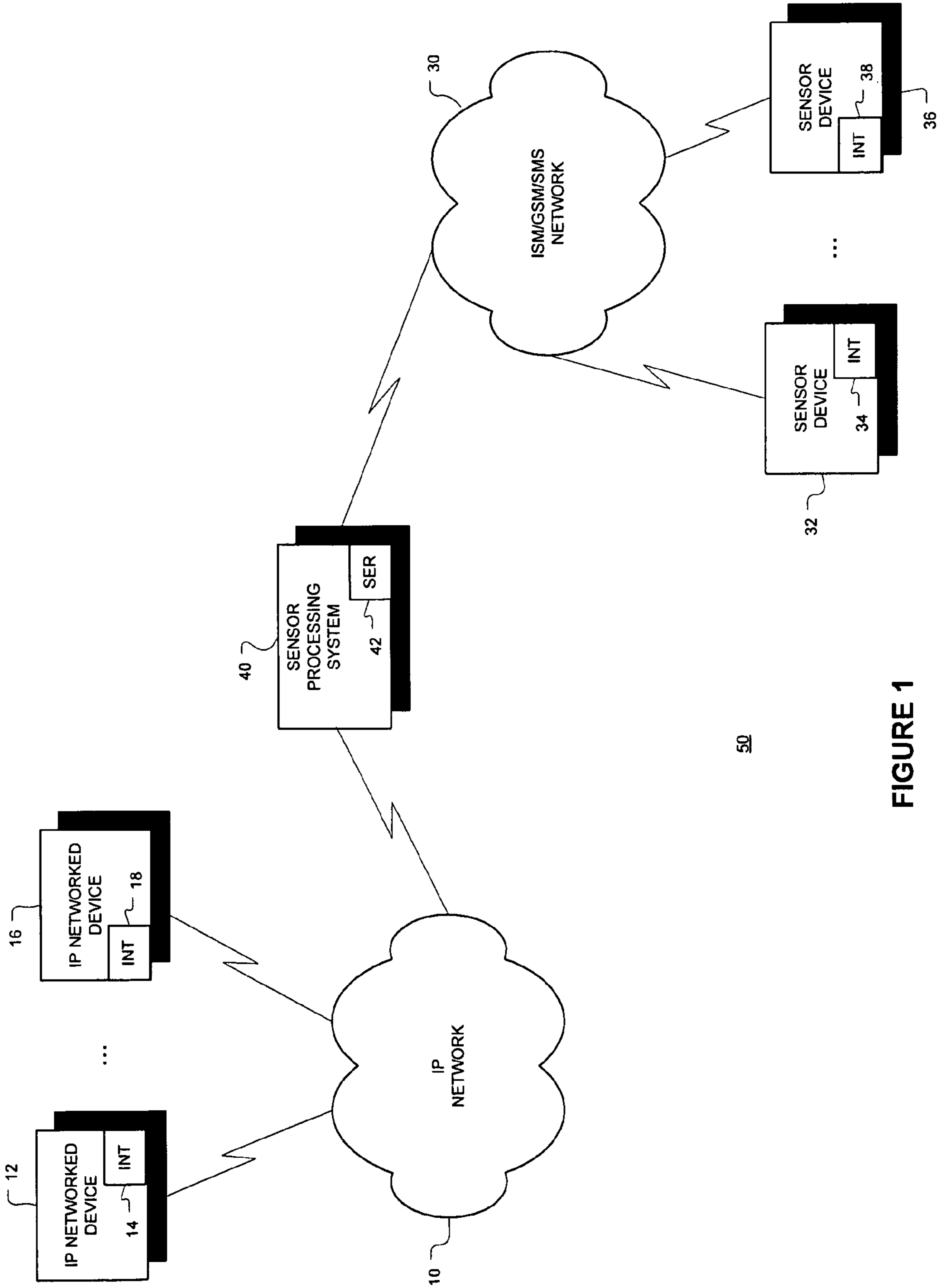


FIGURE 1

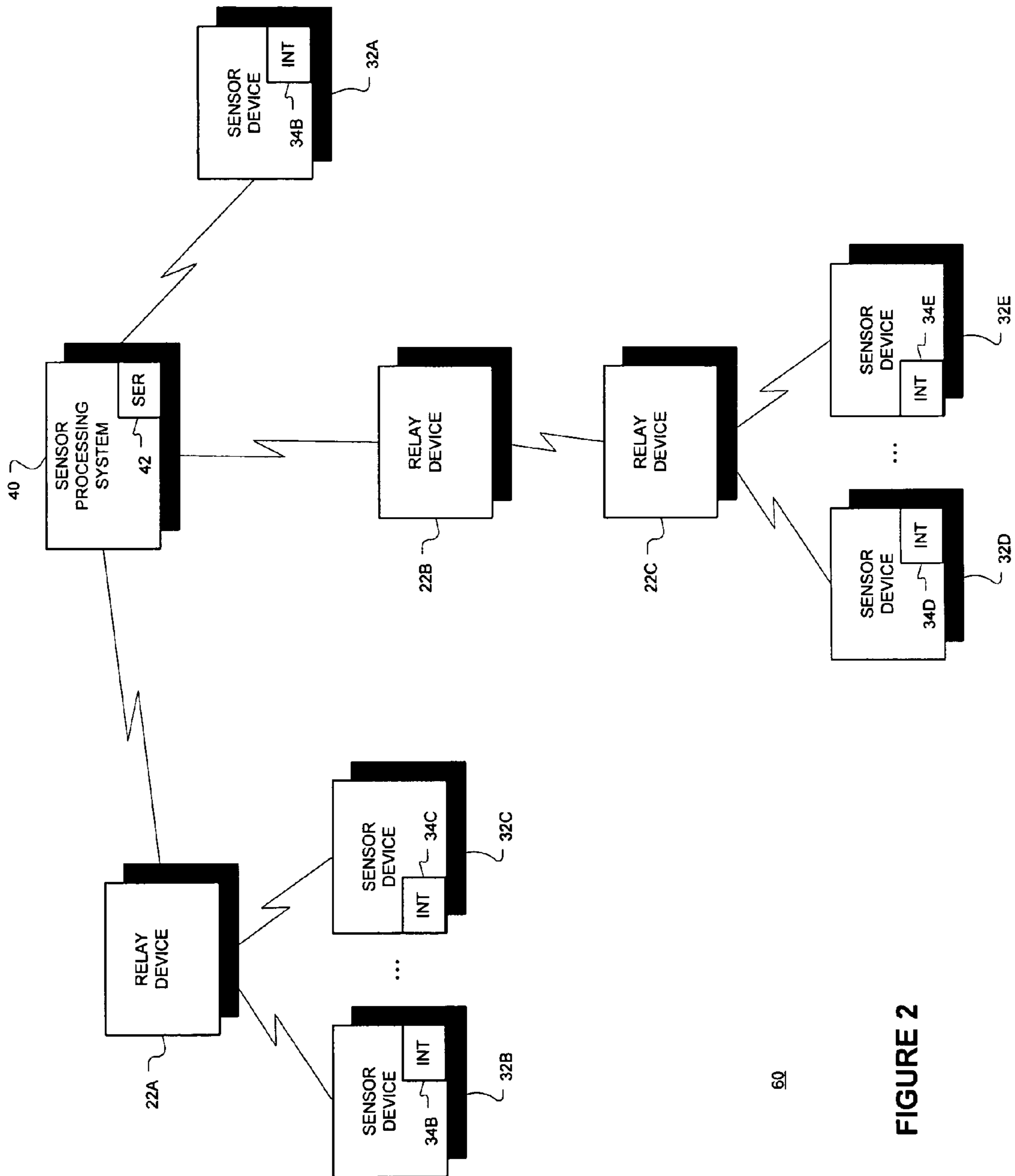


FIGURE 2

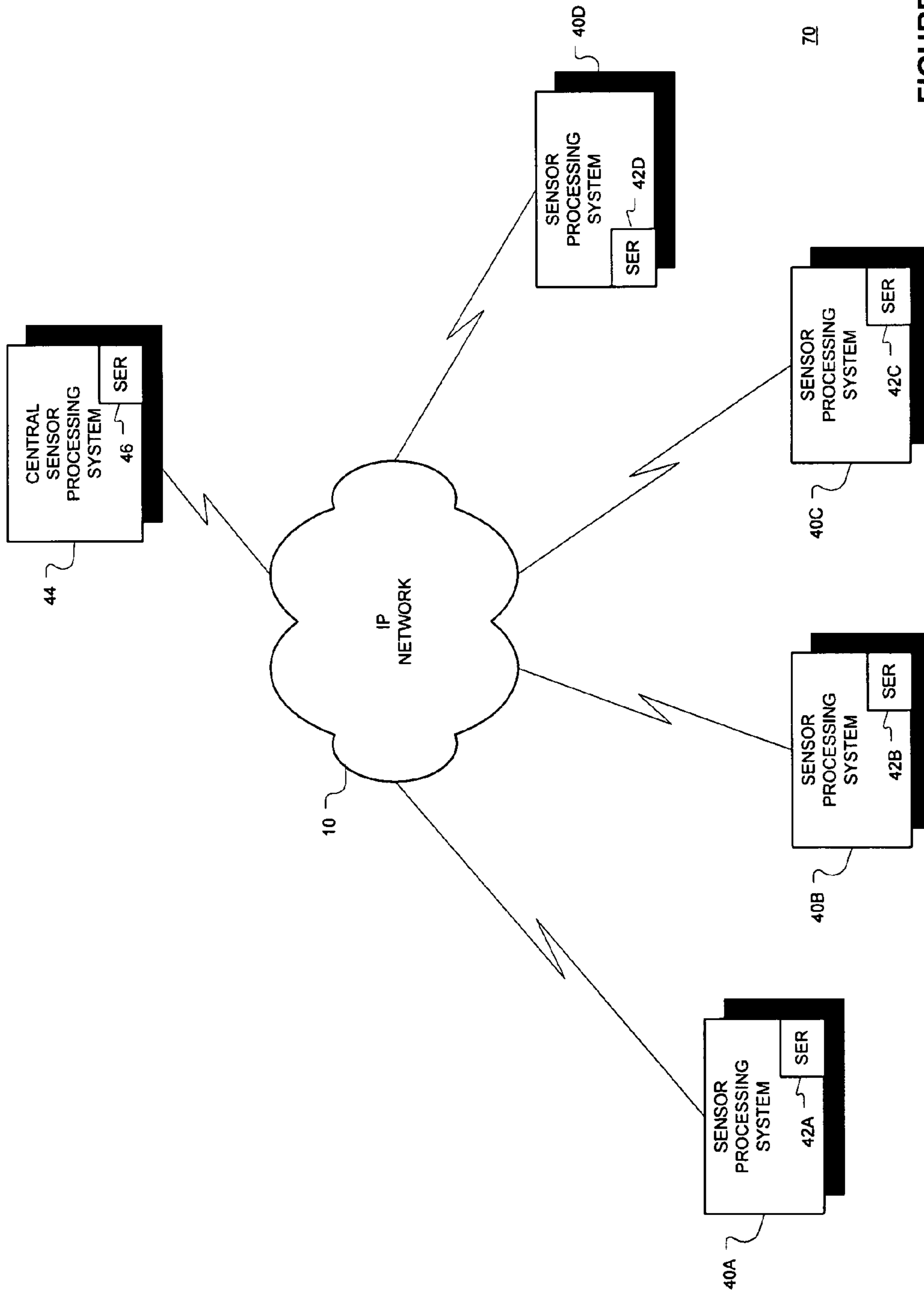
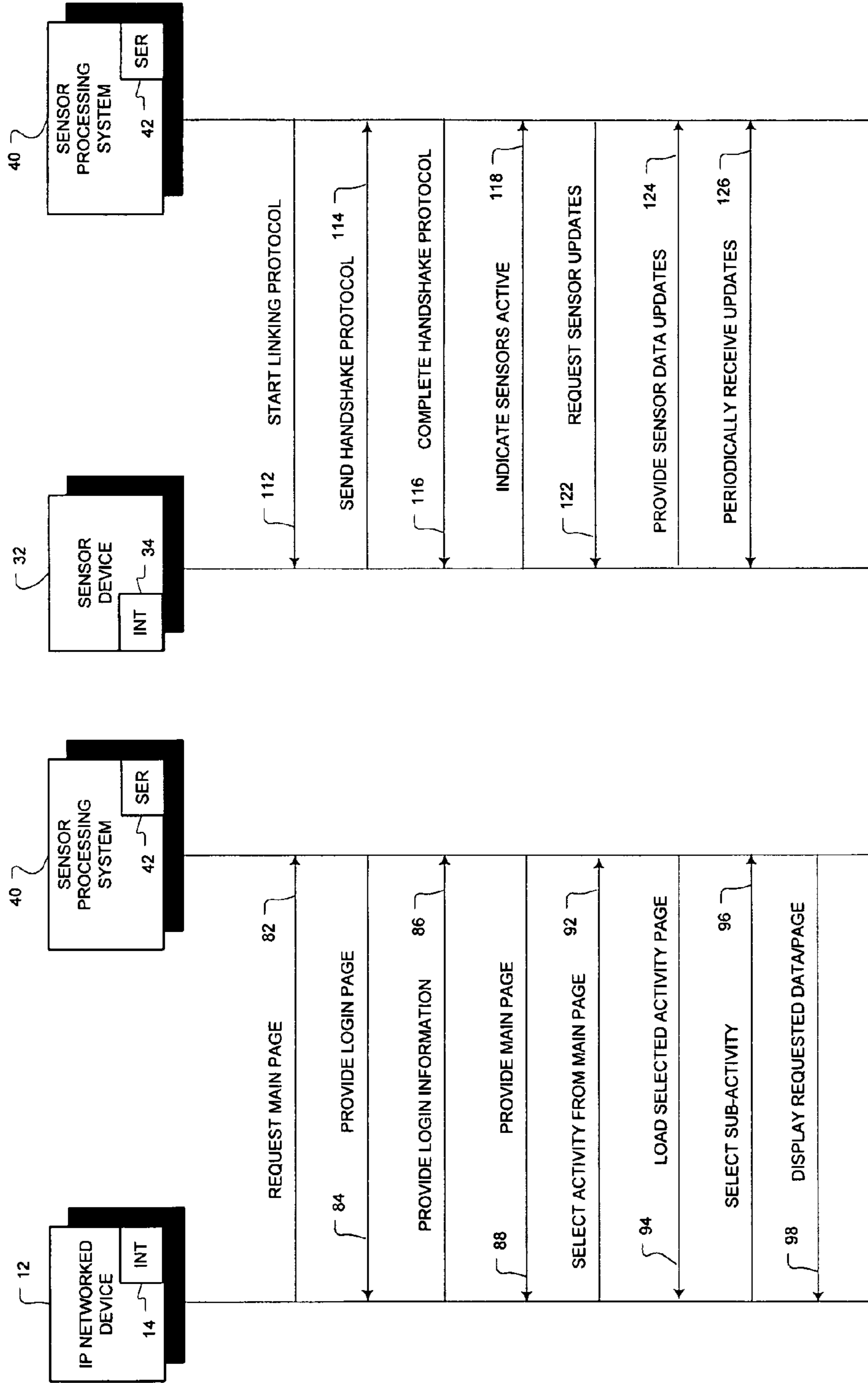


FIGURE 3



80

FIGURE 4A

110

FIGURE 4B

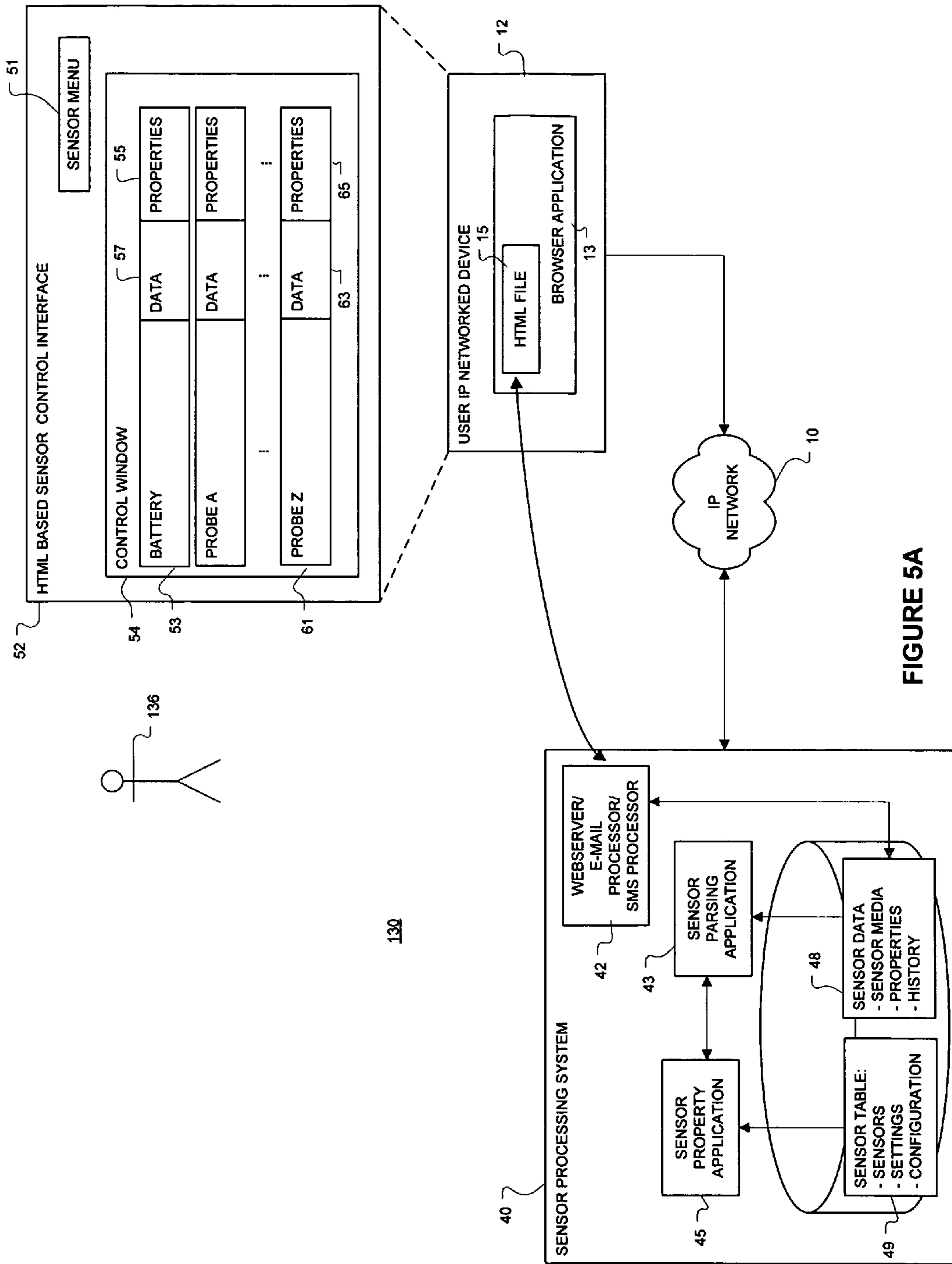


FIGURE 5A

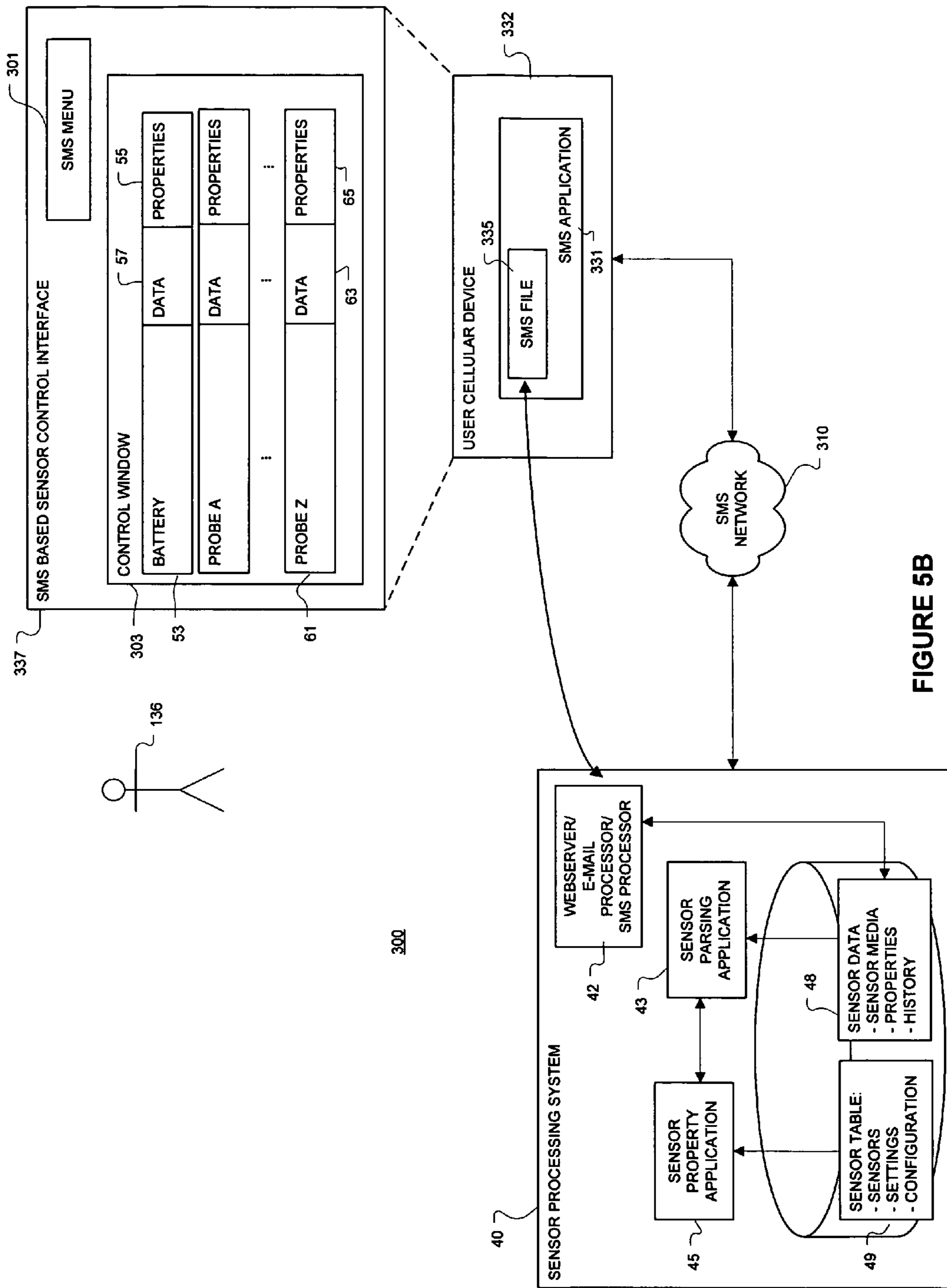
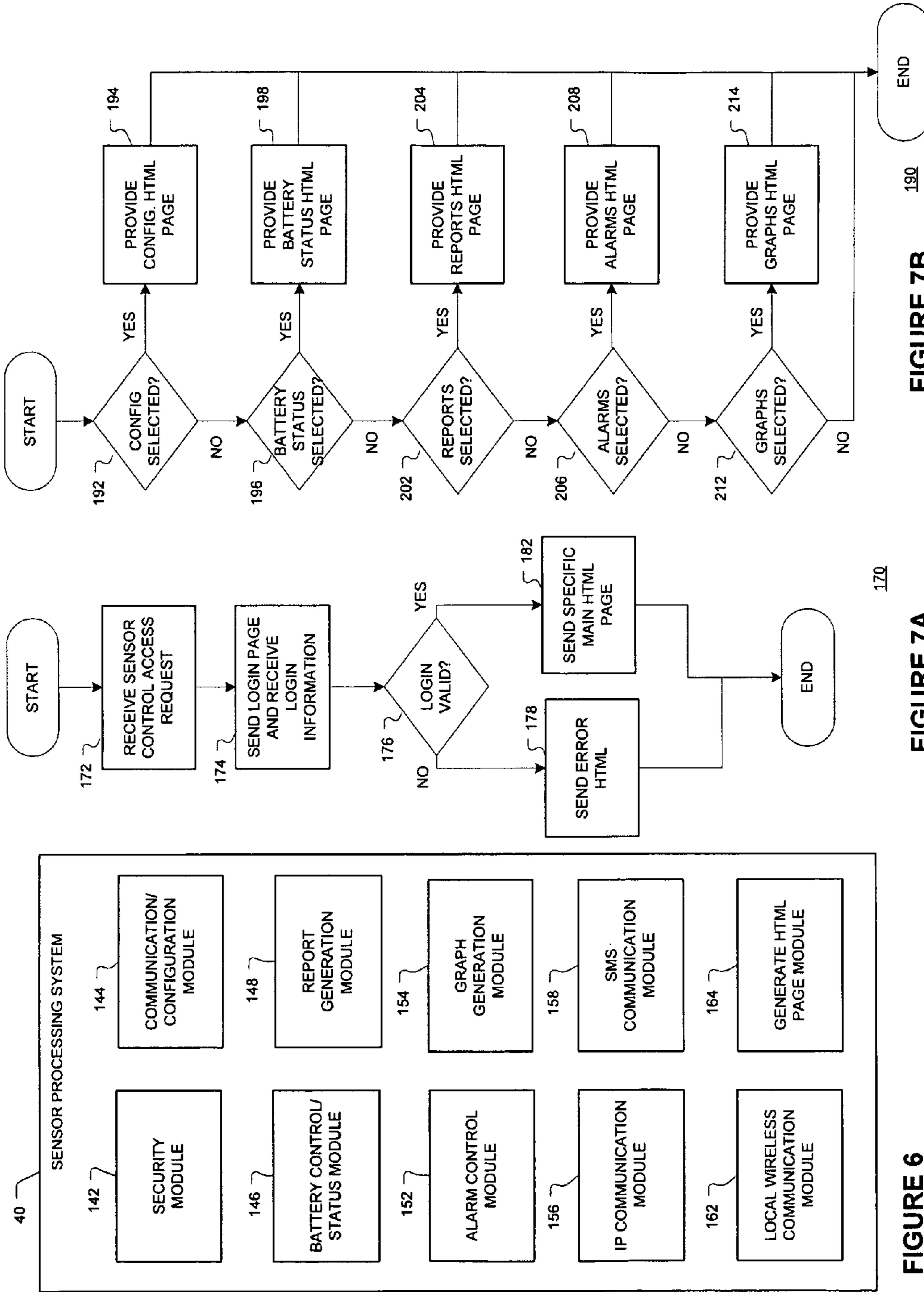


FIGURE 5B



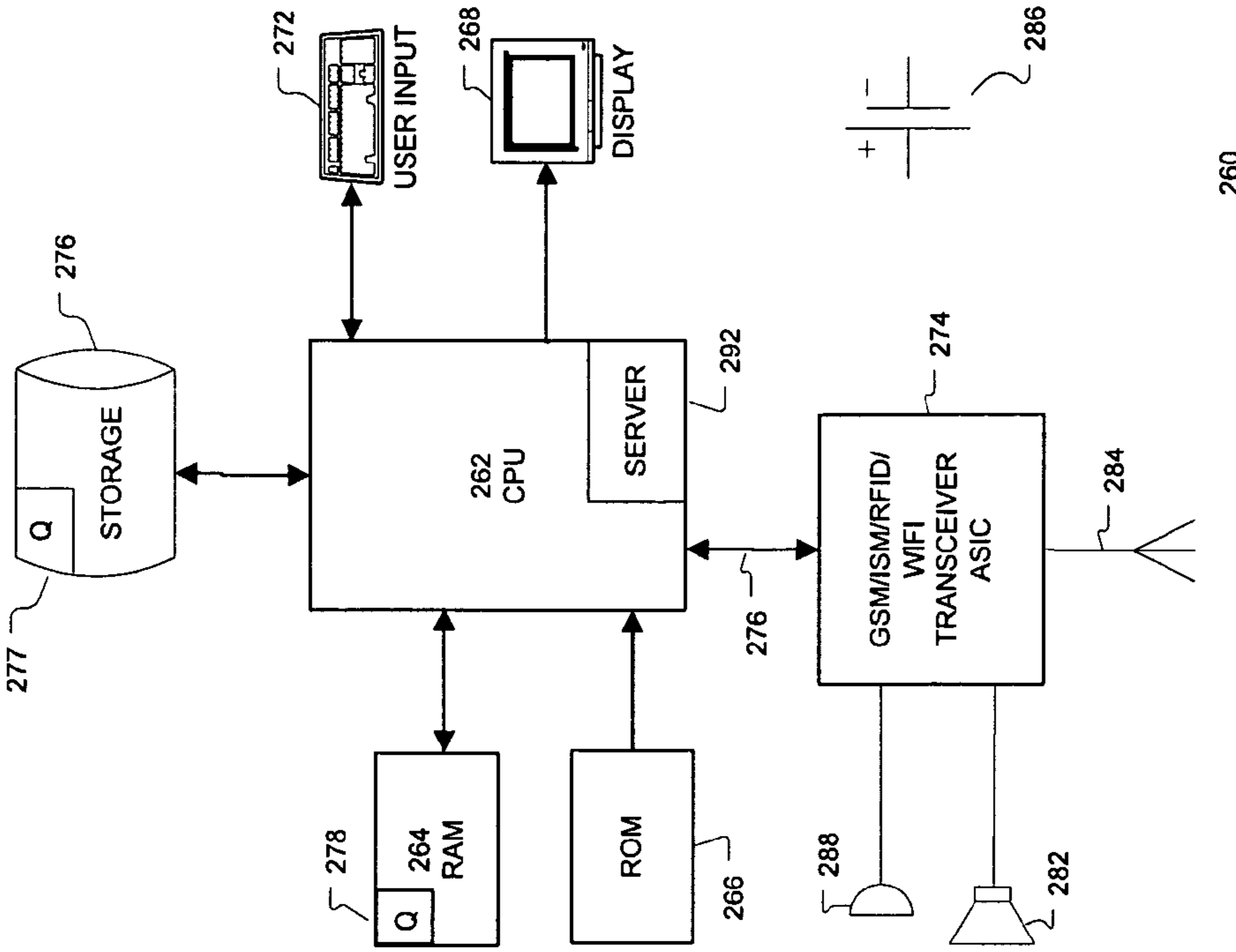


FIGURE 9

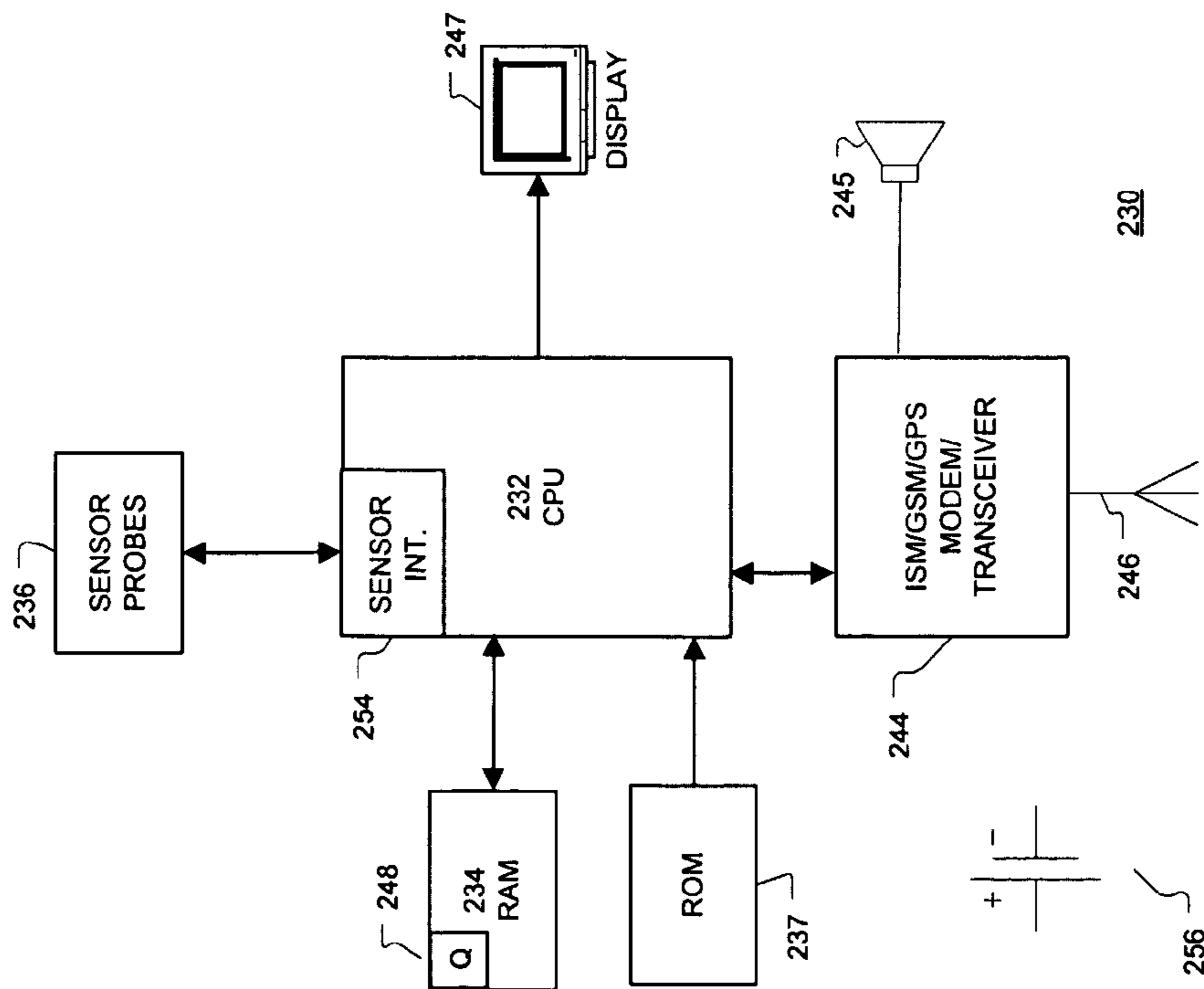


FIGURE 8

ARCHITECTURE, SYSTEM AND METHOD FOR MODULAR ENVIRONMENTAL CONDITIONS AND OBJECT SENSING

TECHNICAL FIELD

Various embodiments described herein relate generally to modular environmental condition and object sensing, including apparatus, systems, and methods used in modular environmental conditions and object sensing.

BACKGROUND INFORMATION

It may be desirable to sense environmental conditions and objects at several locations. The present invention provides embodiments that may be used to sense environmental conditions and objects at several locations.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of wireless networked modular sensor architecture according to various embodiments.

FIG. 2 is a block diagram of wireless modular sensor architecture according to various embodiments.

FIG. 3 is a block diagram of wireless sensor architecture with a central sensor system according to various embodiments.

FIG. 4A is a diagram of communication between an IP networked device and a sensor processing system in a wireless networked modular sensor architecture according to various embodiments.

FIG. 4B is a diagram of communication between a sensor processing system and a sensor device in a wireless networked modular sensor architecture according to various embodiments.

FIG. 5A is a block diagram of sensor processing architecture according to various embodiments.

FIG. 5B is a block diagram of sensor processing architecture according to various embodiments.

FIG. 6 is a block diagram of a sensor processing system according to various embodiments.

FIG. 7A is a flow diagram illustrating several methods according to various embodiments.

FIG. 7B is a flow diagram illustrating several methods according to various embodiments.

FIG. 8 is a block diagram of an article according to various embodiments.

FIG. 9 is a block diagram of an article according to various embodiments.

DETAILED DESCRIPTION

FIG. 1 is a block diagram of sensor processing architecture 10 comprising a sensor processing system (SPS) 40 and several user devices including a plurality of IP networked devices 12, 16, and a plurality of sensor devices 32, 36, according to various embodiments. In an embodiment the sensor processing system (SPS) 40 may be a multi-sensor processing system that may process multiple sensor (multi-sensor) types including environmental condition and object sensing but will be referred to as a sensor processing system (SPS) 40 hereafter. The multi-sensor types may include environmental condition and object sensors. The SPS 40 may include a server 42 that may enable communication between the SPS 40 and the plurality of IP networked devices 12, 16, a central sensor processing system (44 FIG. 3), the plurality of sensor devices 32, 36, and relay devices (22A-C FIG. 2). The SPS 40 may

also communicate with the plurality of sensor devices 32, 36, and relay devices (22A-C FIG. 2) via an application specific integrated circuit (ASIC) (274 FIG. 9).

In an embodiment the IP networked devices 12, 16 may be coupled to the SPS 40 via an IP network 10. The IP network 10 may be a local network, a network of networks, or a worldwide network of networks, termed the "Internet". Each IP networked device 12, 16 may include an interface 14, 18 that enables communication between the IP networked device 12, 16 and the SPS 40 server 42 via the IP network 10. The sensor devices 32, 36 may be coupled to the SPS 40 via a network 30. The network 30 may be a terrestrially based network or satellite based network, or combination thereof. Each sensor device 32, 36 may include an interface 34, 38 that enables communication between the sensor device 32, 36 and the SPS 40 server 42 via the network 30. In an embodiment the network 30 may be an industrial, scientific and medical (ISM) radio bands, Groupe Spécial Mobile (GSM), Code-division multiple access (CDMA), time division multiple access (TDMA), mesh, and short messaging system (SMS) based network. Upon initialization of a sensor device 32, 36, the device 32, 36 may link with the sensor processing system 40 using various protocols including a handshake protocol.

FIG. 2 is a block diagram of a sensor processing system architecture 60 according to various embodiments. Architecture 60 may include a single sensor processing system (SPS) 40 coupled to a plurality of sensor devices 32(A-E). Each sensor device 32(A-E) may be wirelessly coupled to the SPS 40 via a wireless network 30. Depending on physical characteristics of the SPS 40 location and sensor devices 32(A-E), a sensor device 32(A-E) may have a limited communication range (predetermined distance) in an embodiment. In such physical environment one or more wireless signal relays 22(A-C) may be located between one or more sensor devices 32(A-E). As shown in FIG. 2, several wireless signal relays 22B, 22C may be located between a SPS 40 and a sensor device 32D, 32E as a function of range and physical factors between the SPS 40 and sensor devices 32D, 32E.

In an embodiment, one or more of the SPS 40, relay devices 22(A-C), and sensor devices 32(A-E) may include a wireless transceiver for communicating signals on the wireless network 30. In such an embodiment a SPS 40 may automatically detect relays 22(A-C) and sensor devices 32(A-E) in a SPS network 60. A SPS 40 may send a polling signal that is echoed by relays 22(A-C) and sensor devices 32(A-E) in the network including the linkage between a sensor device 32D and one or more relays 22B, 22C to the SPS 40. The sensor devices 32(A-E) may also communicate with one or more sensing apparatus to sense one or more environmental conditions or objects that are coupled to the sensor device 32(A-E). A user via IP networked device 12, 16 may also configure the relationship between a SPS 40, sensor devices 32(A-E), and relays 22(A-C). In an embodiment a combination of automatic configuration and user selection via an IP networked device 12, 16 may be employed. In an embodiment the relays 22A-C may not be detected by a sensor device 32A-C or sensor processing system 40. A relay 22A-C may repeat signals communicated between a sensor device 32A-C and sensor processing system 40. The communicated signal may include a repeat count value that a relay device 22A-22C evaluates. A relay device 22A-22C may not relay a signal having a repeat count value greater than a predetermined value, n (where n may be 3 or more in an embodiment).

FIG. 3 is a block diagram of a sensor processing system architecture 70 according to various embodiments. Architecture 70 may include a central sensor processing system (SPS) 44 coupled to a plurality of SPS 40(A-D) via an internet

protocol (IP) network 10. The central SPS 44 may communicate with each SPS 40(A-D) to configure each SPS 40(A-D) and store information or data collected by each SPS 40(A-D) from sensor devices 32, 36, 32(A-E) coupled to the SPS 40(A-D). The central SPS 44 may backup each SPS 40(A-D) and configure the sensor devices 32, 36, 32(A-E) wirelessly coupled to each SPS 40(A-D). A user via an IP networked device 12, 16 may also control one or more SPS 40(A-D) and sensor devices 32, 36, 32(A-E) via the central SPS 44. It is noted that each SPS 40(A-D) may be wired or wirelessly coupled to the IP network 10. The central SPS 44 may also be wired or wirelessly coupled to the IP network 10.

In an embodiment the interfaces 14, 18, 34, and 38 may each include a hyper-text markup language (HTML) converter such as a browser and the servers 42, 46 may communicate sensor and sensor manipulation controls to a device 12, 16, 32, 36 via one or more web pages. Further, the interfaces 14, 18, 34, and 38 may convert digital signals to Dual-tone multi-frequency (DTMF) signals where combinations of the DTMF signals may control the manipulation of sensor signals that may be generated or forwarded from a device 12, 16, 32, 36. Also the interfaces 14, 18, 34, and 38 may enable messaging services between a device 12, 16, 32, 36 and a server 42. The messaging services may include short messaging service (SMS) based messages that may control the manipulation of sensor signals and enable receipt of sensor information including alarm conditions.

FIG. 4A is a diagram of communications 80 between an SPS 40 and an IP networked device 12 according to various embodiments. In an embodiment, a user via an IP networked device 12, 16 may desire to communicate with a SPS 40, 40(A-D). A user via an IP networked device 12, 16 including an IP enabled device may request a main page or other control or data page 82 from the SPS 40 server 42. In an embodiment the SPS 40 server 42 may receive and process any IP requests 82 directly. In response to a page request 82 from an IP networked device 12, an SPS 40 server 42 may determine whether the user has an active session and provide a main page 88 via the server 42 and IP network 10 when an active session is detected. Otherwise an SPS 40 server 42 may provide a login page 84 to user via the IP network 10 and IP networked device 12, 16. A user via an IP networked device 12, 16 may provide login credentials 86.

Based on the user credentials provided in the login information 86, the SPS 40 server 42 may provide a specific or generic page 88 enabling particular or generic control or data access for the SPS 40, relays 22(A-C), and sensor devices 32, 36, 32(A-E). A user via an IP networked device 12, 16 may select an activity 92 from the provided page 88. The activity may include configuring the SPS 40, server 42, relay 22(A-C), or sensor devices 32, 36, 32(A-E), retrieving data from one or more sensor probes (236 FIG. 8) coupled to one or more sensor devices 32, 36, 32(A-E), requesting a graph or report summarizing or detailing SPS 40, server 42, relay 22(A-C), or sensor devices 32, 36, 32(A-E) configuration, operation conditions (including battery level(s)), communication statistics, one or more sensor probe data (236 FIG. 8) from one or more sensor devices 32, 36, 32(A-E), security settings, user settings, and other settings.

A user via an IP networked device 12, 16 may select one or more activities 92 from the provided page. The SPS 40 server 42 may receive the activity requests 92 and perform the activities as appropriate including forwarding a selected activity page 94 to user's IP networked device 12, 16. The user via the IP networked device 12, 16 may select one or more sub-activities 96 from the provided page 94. The SPS 40 server 42 may receive the sub-activity requests 96 and perform the

sub-activities as appropriate including forwarding a selected sub-activity page 98 to user's IP networked device 12, 16.

FIG. 4B is a diagram of communications 110 between an SPS 40 and a sensor device 32 according to various embodiments. In an embodiment, a SPS 40 relationship to one or more sensor devices 32, 36, 32(A-E) may be established manually or automatically using a handshake protocol. In an embodiment a SPS 40 may forward a start linking protocol message 112 wirelessly via the network 30 using various predetermined protocols. One or more sensor devices 32, 36, 32(A-E) may send a response signal or send handshake protocol 114 to an SPS 40 providing the protocol message 112. The SPS 40 may acknowledge a communication link has been established with a sensor device 32, 36, 32(A-E). The SPS 40 may provide a predetermined channel or bandwidth segment or mask to a sensor device in the start linking protocol message 112 or the complete handshake protocol message 116.

In an embodiment a predetermined channel or bandwidth segment or mask for initial linking may be used for the linking protocol activity 112, 114, 116. A sensor device 32, 36, 32(A-E) may provide an indication of the number, type, and data parameters of one or more sensor probes (236 FIG. 8) electronically coupled to the sensor device 118. The SPS 40 may store the sensor device configuration data including sensor probe 236 information in one or more databases 277, 276, 278 (FIG. 9). A SPS 40 may periodically request 122 or the sensor device 32, 36, 32(A-E) may periodically provide (126) an indication of the number, type, and data parameters of one or more sensor probes (236 FIG. 8) electronically coupled to the sensor device 118 (message 124). The SPS 40 may store the sensor device configuration data including sensor probe 236 information in one or more databases 277, 276, 278 (FIG. 9). The SPS 40 may also evaluate the received sensor probes 236 information (124, 126) to determine alarm conditions, sensor status, and other status. The SPS 40 may store the determined conditions in the one or more databases 277, 276, 278 (FIG. 9).

FIG. 5A is a block diagram of sensor processing architecture 130 comprising a sensor processing system (SPS) 40 coupled to an IP networked device 12, 16 via an IP network 10 according to various embodiments. The SPS 40 may include a hypertext meta language (HTML) generator or webserver, E-mail processor, and SMS processor 42, sensor parsing application 43, sensor property application 45, sensor table 49, and sensor data table or queue 48. The device 12 may include a browser application 13 as part of the interface 14 to receive process, generate, and communicate HTML pages between itself and the SPS 40. The device 332 may include a SMS application 331 to receive process, generate, and communicate SMS messages between itself and the SPS 40 (such as shown in FIG. 5B). The device 12 may provide a user 136 a sensor control or manipulation interface 52. The interface 52 may include a sensor menu 51 and SPS control window 54. The SPS control window 54 may list devices to be controlled including SPS 40 and sensor devices 32, 36, 32(A-E) batteries 53, sensor devices 32, 36, 32(A-E) and sensor probes A to Z 61 coupled to a sensor devices 32, 36, 32(A-E), device data 57, 63 (such as battery level(s), probe level(s)), and device properties (including status, range, location, configuration) 55, 65 for one or more active devices effectively coupled to the SPS 40 where the devices may be actually coupled to a sensor device 32, 36, 32(A-E).

The SPS 40 webserver—E-mail processor—SMS processor 42 may receive sensor device, SPS 40, and sensor probe 236 processing or manipulation requests from the device 12. The requests may be embedded in an HTML page (main, activity, sub-activity page), SMS message(s), or include one

or more DTMF signals (where the device **12** may include a dial pad and be selectable via the sensor control interface **52**.) The webserver/E-mail processor and SMS processor **42** may extract sensor device, SPS **40**, and sensor probe **236** status, report, graph, or configuration requests from received HTML content, SMS message(s) or DTMF signal(s) for storage in the sensor data table **48**. The sensor parsing application **43** may retrieve and process requests stored in the sensor data table **48**. The sensor parsing application **43** may first determine whether the request is valid and permissible for the requester and inform the requestor if invalid and remove invalid requests. Otherwise the sensor parsing application **43** may process the request in conjunction with the sensor property application **45** as a function of the request.

The sensor property application **45** may change one or more properties of a sensor devices **32, 36, 32(A-E)**, SPS **40(A-D)**, and sensor probe **236** stored in the sensor table or queue **49** or sensor data table **48**. The sensor table **49** may store information about users, sensor devices **32, 36, 32(A-E)**, SPS **40(A-D)**, and sensor probes **236** coupled to a sensor device **32, 36, 32(A-E)**. The user information may include sensor format preferences, sensor property preferences, sensor control and access privileges. The sensor parsing application **43** and sensor property application **45** may modify the configuration of sensor devices **32, 36, 32(A-E)**, SPS **40(A-D)**, and sensor probes **236** coupled to a sensor device **32, 36, 32(A-E)** and store the updated configurations in the sensor table **49** and forward representations of current configuration (s) to the device **12**.

The sensor parsing application **43** and sensor property application **45** may also receive status updates and data (including data representing environmental conditions and objects at or near the devices) from sensor devices **32, 36, 32(A-E)**, SPS **40(A-D)**, and sensor probes **236** coupled to a sensor device **32, 36, 32(A-E)** and store the received status and data in the sensor data table or queue **48** and may forward representations of received status/data to the device **12**. The environmental conditions at or near sensor devices **32, 36, 32(A-E)**, SPS **40(A-D)**, and sensor probes **236** coupled to a sensor device **32, 36, 32(A-E)** may include temperature, humidity, pH levels, salinity levels, gas chromatograph information, electrical energy measurements, gas characteristics (pressure, flow, barometric pressure), and any other physically measurable environmental condition.

A probe **236** may digitally determine these conditions and provide a digital signal having variable signals levels indicating the environmental condition to a sensor device **32, 36, 32(A-E)**. A probe **236** may use analog measurements to determine these conditions and provide an analog signal having variable analog signals levels indicating the environmental condition to a respective sensor device **32, 36, 32(A-E)**. The sensor device **32, 36, 32(A-E)** may include a sensor probe **236** interface **254** (FIG. **8**) that may communicate digital or analog data signals with the sensor probe(s) **236**. In an embodiment the sensor interface **254** may include an analog to digital (A/D) converter and a digital to analog converter (A/D). A user **136** may perceive sensor devices **32, 36, 32(A-E)**, SPS **40(A-D)**, and sensor probes **236** coupled to a sensor device **32, 36, 32(A-E)** configuration and data by selecting the device **53, 61** via the control window **54**.

FIG. **5B** is a block diagram of sensor processing architecture **300** comprising a sensor processing system (SPS) **40** coupled to a user cellular device **332** via a cellular network **310** according to various embodiments. The cellular device **332** may include an SMS application **331** to receive process, generate, and communicate SMS message(s) **335** between itself and the SPS **40**. The device **332** may provide a user **136**

a SMS based sensor control or manipulation interface **337**. The interface **337** may include an SMS menu **301** and control window **303**. The SMS control window **303** may list devices to be controlled including the SPS **40** and sensor devices **32, 36, 32(A-E)** batteries **53**, sensor devices **32, 36, 32(A-E)** and sensor probes A to Z **61** coupled to a sensor devices **32, 36, 32(A-E)**, device data **57, 63** (such as battery level(s), probe level(s)), and device properties (including status, range, location, configuration) **55, 65** for one or more active devices effectively coupled to the SPS **40** where the devices may be actually coupled to a sensor device **32, 36, 32(A-E)**.

In an embodiment a SPS **40** sensor property application **45** and sensor parsing application **43** may determine when a sensor devices **32, 36, 32(A-E)** batteries **53**, a sensor device **32, 36, 32(A-E)** or a sensor probes **236, A to Z 61** coupled to a sensor devices **32, 36, 32(A-E)** is operating outside of predetermined configured settings (as stored in the sensor table **49**) or data collected from a sensor probes **236, A to Z 61** coupled to a sensor devices **32, 36, 32(A-E)** is outside a predetermined range or range(s) (as stored in the sensor data table **48** properties). Based on the configuration or properties, the sensor property application **46** and sensor parsing application **44** may determine the level of variance outside predetermined desired level(s) (configured settings for a SPS **40**, a sensor devices **32, 36, 32(A-E)** batteries **53**, a sensor device **32, 36, 32(A-E)** or a sensor probes **236, A to Z 61** coupled to a sensor devices **32, 36, 32(A-E)** is operating outside of predetermined configured settings (as stored in the sensor table **49**) or data collected from a sensor probes **236, A to Z 61** coupled to a sensor devices **32, 36, 32(A-E)**.

The SPS **40** sensor property application **45** and sensor parsing application **43** may then perform various user notifications based on the determined variance level(s) and the related notification configuration for sensor devices **32, 36, 32(A-E)** batteries **53**, sensor device **32, 36, 32(A-E)** or sensor probes **236, A to Z 61** coupled to a sensor devices **32, 36, 32(A-E)** that is operating outside of range. The SPS **40** or sensor device **32, 36, 32(A-E)** may provide a user perceptible signal including an audible (via speakers **282** FIG. **9** or **245** FIG. **8**) or visual signals (displays **268** FIG. **9** or **247** FIG. **8**) to indicate the respective variance levels. The SPS **40** may also provide variance level indications via the IP networked device **12, 16**, SMS based, cellular device **332**, or plain old telephone system (POTS) **332** network. In an embodiment the application **45** may dial one or more telephone numbers assigned to users as a function of the variance and error type. The application **45** may employ voice synthesizers to leave voice mail messages related to the error(s) and variance(s). The SPS **40** may also send variance level indication messages to one or more users via the E-mail processor **42** where the users to receive the SMS or E-mail messages may be configured in the sensor table **49** and be determined as a function of the variance level.

In an embodiment, the SPS **40** may further include a number of modules such as shown in FIG. **6** including a security module **142**, a communication configuration module **144**, a battery control module **146**, a report generation module **148**, an alarm control module **152**, a graph generation module **154**, an IP communication module **156**, an SMS communication module **158**, an local wireless communication module **162**, and a generate HTML page module **164**. In an embodiment, the security module **142** may process user login requests from an IP networked device **12, 16** or an SMS device **332** to determine the user's credentials to configure or receive information from the corresponding SPS **40, 40(A-D)** and related sensor devices **32, 36, 32(A-E)**. The security module **142** may control the operations and data that are shown on control

interface **337, 52** and the user's ability to modify configurations and clear error or alarm messages or conditions.

The communication control module **144** may control communication between the SPS **40** and IP networked devices **12, 16**, SMS devices **332**, sensor devices **32, 36, 32(A-E)** and relays **22(A-C)**. The module **144** may automatically link sensor devices **32, 36, 32(A-E)** and relays **22(A-C)** based on relative proximity to the SPS **40** or user specified preferences or settings for the SPS **40** and the related sensor devices **32, 36, 32(A-E)** and relays **22(A-C)**. The communication control module **144** may work in conjunction with the security module **142** to limit communications as a function of the user's credentials and perform the process **170** shown in FIG. 7A.

In the process **70**, an SPS **40** may receive a sensor control access request (activity **172**) from a user **136** via an IP networked device **12, 16** or SMS device **332**. The SPS **40** via the generate HTML page module **164** may generate a login page based on the requesting device. The IP communication module **156** or SMS communication module **158** may forward the login page as appropriate for the requesting device (IP device **12, 16** or SMS device **332**) (activity **174**). It is noted that an IP device **12, 16** may also be able to process SMS messages on the SMS network **310**. The SPS **40** via the IP communication device **156** or SMS communication module **158** may receive a user's **136** login information and provide the login information to the security module **142** for credential determination (activity **176**). If the user's credentials are invalid or not cleared with the SPS **40**, an login error page HTML may be generated by the generate HTML page module and the IP communication device **156** or SMS communication module **158** may forward the login error page as appropriate for the requesting device (IP device **12, 16** or SMS device **332**) (activity **178**). The security module **142** may track the invalid or inappropriate logins and lock out the IP device **12, 14** or SMS device **332** based on a unique device **12, 14, 332** identifier including a Media Access Control (MAC) address.

Based on the user's credentials as determined by the security module **142**, the generate HTML page module may generate a user specific main page (activity **182**). The IP communication device **156** or SMS communication module **158** may forward the user specific main page as appropriate for the requesting device (IP device **12, 16** or SMS device **332**) (activity **182**). The IP communication module **156** may enable the SPS **40** to communicate with an IP device **12, 16** via wired or wireless IP signals. It is noted that one or more sensor devices **32, 36, 32(A-E)** or relays **22(A-C)** may be IP networked wireless devices in an embodiment and the IP communication module **156** may communicate with such sensor devices **32, 36, 32(A-E)** or relays **22(A-C)** using a wireless IP signal. The IP communication module may be able to communicate wirelessly using various wireless communication standards including Institute of Electrical and Electronics Engineers (IEEE) 802.11 standard (including 802.11a, 802.11b, 802.11g, 802.11n).

The SMS communication module **158** may enable the SPS **40** to communicate with an SMS device **332** via a wired or wireless SMS signal where Short Message Service (SMS) is a communication service standardized in the Groupe Special Mobile (GSM) mobile communication system. It is noted that one or more sensor devices **32, 36, 32(A-E)** or relays **22(A-C)** may be SMS devices in an embodiment and the SMS communication module **158** may communicate with such sensor devices **32, 36, 32(A-E)** or relays **22(A-C)** using the SMS communication service standard. The SMS communication module may be able to communicate wirelessly using various wireless SMS communication standards particular to various SMS networks **310**.

The local wireless communication module **162** may enable the SPS **40** to communicate with sensor devices **32, 36, 32(A-E)** or relays **22(A-C)** via wireless signals. It is noted that one or more user devices **12, 16** may be local wireless devices in an embodiment and the local wireless communication module **162** may communicate with such devices **12, 16** using a local wireless signal. The local communication module **162** may be able to communicate wirelessly using various wireless communication standards including the industrial, scientific and medical (ISM) radio bands, Groupe Spécial Mobile (GSM), Code-division multiple access (CDMA), time division multiple access (TDMA), mesh, and other wireless standards, formats, and protocols that may be employed locally. The local wireless communication protocol used by the local wireless communication module **162** may affect the communication range and battery life of the SPS **40**, sensor devices **32, 36, 32(A-E)**, or relays **22(A-C)**.

The generate HTML page module **164** may use process **190** in FIG. 7B to generate HTML pages for an IP networked device **12, 16** including a login page and main page. Based on a user's selection the HTML page module **164** may generate a configuration HTML page (activity **194**) when a user selects configuration from a main page or other page having the configuration selection (activity **192**). The configuration HTML page may enable a user in conjunction with the communication/configuration module **144** to modify one or more configuration settings for the SPS **40**, sensor devices **32, 36, 32(A-E)** or relays **22(A-C)**, and the sensor probes **236** coupled the sensor devices. As noted the configuration parameters may include alarm ranges and topology between the SPS **40**, sensor devices **32, 36, 32(A-E)** or relays **22(A-C)**.

The HTML page module **164** may generate a battery status HTML page (activity **198**) when a user selects battery status from a main page or other page having the battery status selection (activity **196**). The battery status HTML page may enable a user in conjunction with the battery control/status module **146** to modify one or more battery usage settings and battery levels for batteries (**286** FIG. 9, **256** FIG. 8) of the SPS **40**, sensor devices **32, 36, 32(A-E)** or relays **22(A-C)**. The SPS **40**, sensor devices **32, 36, 32(A-E)** or relays **22(A-C)** configuration settings may include battery level alarm and battery usage control including operating intervals of the sensor devices **32, 36, 32(A-E)** or relays **22(A-C)**.

The HTML page module **164** may generate a report generation HTML page (activity **204**) when a user selects reports from a main page or other page having the reports selection (activity **202**). The reports HTML page may enable a user in conjunction with the report generation module **148** to select one or more reports for data related to alarms, sensors, batteries, configurations and other information related to the SPS **40**, the sensor devices **32, 36, 32(A-E)**, the relays **22(A-C)**, or the sensor probes **236** coupled to a sensor device. The report page may also enable a user to create their own report and select the output format and delivery method including via IP protocol, HTML page, and E-mail and the formats may include Powerpoint®, PDF®, Word®, Excel®, and other report formats.

The HTML page module **164** may further generate an alarm status/review/confirmation HTML page (activity **208**) when a user selects alarms from a main page or other page having the alarms selection (activity **206**). The alarms HTML page may enable a user in conjunction with the alarm control module **152** to see alarm status, review stored/detected alarms, and confirm an alarm condition has been addressed for SPS **40**, the sensor devices **32, 36, 32(A-E)**, the relays **22(A-C)**, or the sensor probes **236** coupled to a sensor device. As noted different alarm conditions may be created as a

function of the variance level from the predetermined non-alarm range. After confirmation of an alarm the user confirmation may be stored and reviewable to monitor user's activities. The alarm page may also enable a user to create an alarm specific report and select the output format and delivery method including via IP protocol, HTML page, and E-mail and the formats may include Powerpoint®, PDF®, Word®, Excel®, and other report formats.

Also the generate HTML page module 164 may generate a graphs HTML page (activity 214) when a user selects graphs from a main page or other page having the graphs selection (activity 212). The graphs HTML page may enable a user in conjunction with the graph generation module 154 to select one or more graphs for data related to alarms, sensors, batteries, configurations and other information related to the SPS 40, the sensor devices 32, 36, 32(A-E), the relays 22(A-C), or the sensor probes 236 coupled to a sensor device. The graph page may also enable a user to create their own graph and select the output format and delivery method including via IP protocol, HTML page, and E-mail and the formats may include Powerpoint®, PDF®, Word®, Excel®, and other report formats.

FIG. 8 illustrates a block diagram of a device 230 that may be employed as a sensor device 32, 36, 32(A-E) in various embodiments. The device 230 may include a central processing unit (CPU) 232, a random access memory (RAM) 234, a read only memory (ROM) 237, a local wireless/GPS modem/transceiver 244, display 247, speaker 245, rechargeable electrical storage element 256, and an antenna 246. The CPU 232 may include a sensor interface 254. The RAM 234 may include a queue or table 248 where the queue 248 may be used to store sensor probe data. The rechargeable electrical storage element may be a battery or capacitor in an embodiment.

The modem/transceiver 244 may couple, in a well-known manner, the device 230 to the wireless network 30, IP network 10, or SMS network 310 to enable communication with a SPS 40. In an embodiment, the modem/transceiver 244 may be a wireless modem or other communication device that may enable communication with the SPS 40. The modem/transceiver 244 may also be able to receive global positioning signals (GPS) and the CPU 232 may be able to convert the GPS signals to location data that may be stored in the RAM 248 and provided to a SPS 40. As noted above the sensor probes 236 may generate digital signals that represent environmental condition data or object data (such radio frequency identification (RDIF) information). The sensor probes 236 may also generate analog signals that represent environmental condition data or object data (such radio frequency identification (RDIF) information).

One or more sensor probes may be interchangeably coupled to the device 230. The sensor probes 236 may indicate their type (data type they represent) and calibration when coupled to the sensor interface 254 using digital or analog indicia representative of the sensor probe 236 type and calibration. The ROM 237 may store program instructions to be executed by the CPU 232 or sensor interface 254. The RAM 234 may be used to store temporary program information, queues, databases, and overhead information. The storage device 234 may comprise any convenient form of data storage and may be used to store temporary program information, queues, databases, and overhead information.

A device 260 is shown in FIG. 9 that may be used in various embodiments as a device 12, 16 or SPS 40. The device 260 may include a central processing unit (CPU) 262, a random access memory (RAM) 264, a read only memory (ROM) 266, a display 268, a user input device 272, a transceiver application specific integrated circuit (ASIC) 274, a microphone

288, a speaker 282, bus 276, electrical energy storage unit 286, and an antenna 284. The CPU 262 may include a server 292. The RAM 264 may include a queue 278 where the queue 278 may store sensor data. The server 292 may function as the web-server/e-mail processor/SMS processor 42 of the SPS 40.

The ROM 266 is coupled to the CPU 262 and may store the program instructions to be executed by the CPU 262 and the server 292. The RAM 264 is coupled to the CPU 262 and may store temporary program data, overhead information, and the queues 278. The user input device 272 may comprise an input device such as a keypad, touch pad screen, track ball or other similar input device that allows the user to navigate through menus in order to operate the device 260. The display 268 may be an output device such as a CRT, LCD or other similar screen display that enables the user to read, view, or hear received messages, sensor, or pages from the SPS 40 (in the case of the IP networked device 12, 16).

The microphone 288 and speaker 282 may be incorporated into the device 260. The microphone 288 and speaker 282 may also be separated from the device 260. Received data may be transmitted to the CPU 262 via a serial bus 276 where the data may include messages, sensor data, or pages received, messages, sensor data, or pages to be transmitted, or protocol information. The transceiver ASIC 274 may include an instruction set necessary to communicate messages, sensor data or pages in architecture 10, 30, 310. The ASIC 274 may be coupled to the antenna 284 to communicate wireless messages, sensor data, or pages within the architecture 50, 110. When a message is received by the transceiver ASIC 274, its corresponding data may be transferred to the CPU 262 via the serial bus 276. The data can include wireless protocol, overhead information, sensor data, and pages to be processed by the device 260 in accordance with the methods described herein.

The rechargeable electrical storage element 286 may be a battery or capacitor in an embodiment. The RAM 264 may be any digital storage medium and may be coupled to the CPU 262 and may store temporary program data, overhead information, and the queue 278. The queue 278 may store sensor data and web page information.

Any of the components previously described can be implemented in a number of ways, including embodiments in software. Any of the components previously described can be implemented in a number of ways, including embodiments in software. Thus, the CPU 232, sensor interface 252, server 292, modem/transceiver 244, antenna 246, storage 238, RAM 234, ROM 237, queue 248, queue 256, CPU 262, transceiver ASIC 274, antenna 284, microphone 288, speaker 282, 254, ROM 266, RAM 264, queue 278, user input 272, displays 268, 257, may all be characterized as "modules" herein.

The modules may include hardware circuitry, single or multi-processor circuits, memory circuits, software program modules and objects, firmware, and combinations thereof, as desired by the architect of the architecture 10 and as appropriate for particular implementations of various embodiments.

The apparatus and systems of various embodiments may be useful in applications other than a sales architecture configuration. They are not intended to serve as a complete description of all the elements and features of apparatus and systems that might make use of the structures described herein.

Applications that may include the novel apparatus and systems of various embodiments include electronic circuitry used in high-speed computers, communication and signal processing circuitry, modems, single or multi-processor modules, single or multiple embedded processors, data switches,

11

and application-specific modules, including multilayer, multi-chip modules. Such apparatus and systems may further be included as sub-components within a variety of electronic systems, such as televisions, cellular telephones, personal computers (e.g., laptop computers, desktop computers, hand-held computers, tablet computers, etc.), workstations, radios, video players, audio players (e.g., mp3 players), vehicles, medical devices (e.g., heart monitor, blood pressure monitor, etc.) and others. Some embodiments may include a number of methods.

It may be possible to execute the activities described herein in an order other than the order described. Various activities described with respect to the methods identified herein can be executed in repetitive, serial, or parallel fashion.

A software program may be launched from a computer-readable medium in a computer-based system to execute functions defined in the software program. Various programming languages may be employed to create software programs designed to implement and perform the methods disclosed herein. The programs may be structured in an object-orientated format using an object-oriented language such as Java or C++. Alternatively, the programs may be structured in a procedure-orientated format using a procedural language, such as assembly or C. The software components may communicate using a number of mechanisms well known to those skilled in the art, such as application program interfaces or inter-process communication techniques, including remote procedure calls. The teachings of various embodiments are not limited to any particular programming language or environment.

The accompanying drawings that form a part hereof show, by way of illustration and not of limitation, specific embodiments in which the subject matter may be practiced. The embodiments illustrated are described in sufficient detail to enable those skilled in the art to practice the teachings disclosed herein. Other embodiments may be utilized and derived therefrom, such that structural and logical substitutions and changes may be made without departing from the scope of this disclosure. This Detailed Description, therefore, is not to be taken in a limiting sense, and the scope of various embodiments is defined only by the appended claims, along with the full range of equivalents to which such claims are entitled.

Such embodiments of the inventive subject matter may be referred to herein individually or collectively by the term "invention" merely for convenience and without intending to voluntarily limit the scope of this application to any single invention or inventive concept, if more than one is in fact disclosed. Thus, although specific embodiments have been illustrated and described herein, any arrangement calculated to achieve the same purpose may be substituted for the specific embodiments shown. This disclosure is intended to cover any and all adaptations or variations of various embodiments. Combinations of the above embodiments, and other embodiments not specifically described herein, will be apparent to those of skill in the art upon reviewing the above description.

The Abstract of the Disclosure is provided to comply with 37 C.F.R. §1.72(b), requiring an abstract that will allow the reader to quickly ascertain the nature of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In the foregoing Detailed Description, various features are grouped together in a single embodiment for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted to require more features than are expressly recited in each claim. Rather, inventive subject matter may be

12

found in less than all features of a single disclosed embodiment. Thus the following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separate embodiment.

What is claimed is:

1. A multi-sensor processing module, including:

a multi-sensor wireless transceiver to wirelessly receive environmental sensor data and battery status data from a plurality of physically and mechanically separated sensor data generation modules, each of the plurality of physically and mechanically separated sensor data generation modules including a battery and the environmental sensor data represents one of temperature and humidity near one of the plurality of sensor data generation modules;

an alarm generation module, the alarm generation module determining when received environmental sensor data is not within a predetermined value range and when received battery status data is not within a predetermined value range;

a web page generation module to generate a web page including wirelessly received environmental sensor data from at least two of the physically and mechanically separated sensor data generation modules and alarm generation module determinations;

a non-volatile data storage module to store received environmental sensor data and alarm determinations; and

an internet protocol (IP) signal transceiver, the transceiver wirelessly transmitting the web page to an IP based device.

2. The multi-sensor processing module of claim 1, wherein the multi-sensor wireless transceiver receives environmental sensor data via a non-IP network.

3. The multi-sensor processing module of claim 1, wherein the multi-sensor wireless transceiver receives environmental sensor data via an IP network.

4. The multi-sensor processing module of claim 1, further including an electronic message generation module, the electronic message generation module sending alarm status information to an electronic address.

5. The multi-sensor processing module of claim 4, wherein the electronic address is an E-mail address.

6. The multi-sensor processing module of claim 4, wherein the electronic address is a short message system (SMS) address.

7. The multi-sensor processing module of claim 1 wherein the web page further includes sensor data generation module battery status information.

8. A multi-sensor processing system, including:

a first sensor data generation module including:

a sensor data generation module, the module coupled to a first sensor and generating a first signal representing an environmental condition near the first sensor;

a first battery; and

a wireless transceiver, the transceiver wirelessly transmitting the first sensor and battery status data;

a second sensor data generation module physically and mechanically separate from the first sensor data generation module, including:

a sensor data generation module, the module coupled to a second sensor and generating a second signal representing an environmental condition near the second sensor;

a second battery and

a wireless transceiver, the transceiver wirelessly transmitting the second sensor and battery status data; and

13

a multi-sensor processing module physically and mechanically separate from the first sensor data generation module and the second sensor data generation module, including:

- a multi-sensor wireless transceiver to wirelessly receive first sensor and battery status data and second sensor and battery status data;
- a web page generation module to generate a web page including wirelessly received first sensor and battery status data and second sensor and battery status data; and
- an internet protocol (IP) signal transceiver, the transceiver wirelessly transmitting the web page to an IP based device.

9. The multi-sensor processing system of claim 8, wherein the multi-sensor wireless transceiver receives first sensor and battery status data and second sensor and battery status data via a non-IP network.

10. The multi-sensor processing system of claim 8, wherein first sensor data and second sensor data represents one of temperature and humidity near the respective sensors.

11. The multi-sensor processing system of claim 10, wherein the multi-sensor wireless transceiver receives first sensor and battery status data and second sensor and battery status data via an IP network.

12. The multi-sensor processing system of claim 11, further including a non-volatile data storage module to store received first sensor and battery status data and second sensor and battery status data.

13. The multi-sensor processing system of claim 12, further including an alarm generation module, the alarm generation module determining when received first sensor data, first battery status data, second battery status data, or second sensor data is not within a predetermined value range.

14. The multi-sensor processing system of claim 13, further including an electronic message generation module, the electronic message generation module sending alarm status information to an electronic address.

15. The multi-sensor processing system of claim 14, wherein the electronic address is an E-mail address.

16. The multi-sensor processing system of claim 10, further including a report generation module, the module generating reports related to received first sensor and battery status data and received second sensor and battery status data.

17. The multi-sensor processing system of claim 16, wherein the web page includes a report generation module report.

18. A multi-sensor processing method, including:
wirelessly receiving environmental sensor data and battery status data from a plurality of physically and mechanically separated sensor data generation modules, the environmental sensor data representing one of tempera-

14

ture and humidity near the one of the plurality of sensor data generation modules, and each of the plurality of physically and mechanically separated sensor data generation modules including a battery;

determining when received environmental sensor data is not within a predetermined value range and when received sensor battery status data is not within a predetermined value range;

generating a web page including wirelessly received environmental sensor data from at least two of the physically and mechanically separated sensor data generation modules and not in range sensor data determinations;

storing received environmental sensor data and not in range sensor data determinations in a non-volatile data storage module; and

wirelessly transmitting the web page to an IP based device via an internet protocol.

19. The multi-sensor processing method of claim 18, including wirelessly receiving environmental sensor data via a non-IP network.

20. The multi-sensor processing method of claim 18, further including sending alarm status information to an electronic address.

21. An article including a machine-accessible medium having associated information, wherein the information, when accessed, results in a machine performing the acts of:

wirelessly receiving sensor environmental data and battery status data from a plurality of physically and mechanically separated sensor data generation modules, the environmental sensor data representing one of temperature and humidity near one of the plurality of sensor data generation modules, each of the plurality of physically and mechanically separated sensor data generation modules includes a battery;

determining when received environmental sensor data is not within a predetermined value range and when received sensor battery status data is not within a predetermined value range;

generating a web page including wirelessly received environmental sensor data from at least two of the physically and mechanically separated sensor data generation modules and not in range sensor data determinations;

storing received environmental sensor data and not in range sensor data determinations in a non-volatile data storage module; and

wirelessly transmitting the web page to an IP based device via an internet protocol.

22. The article of claim 21, further performing the act of wirelessly receiving environmental sensor data via a non-IP network.

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